

# **The Contribution of Polystyrene Foam Food Service Products to Litter**

A Technical Report

Prepared by

**Environmental Resources Planning, LLC**

Steven R. Stein, Project Manager

**Final Report**

**May 2012**



**ER PLANNING**

# Table of Contents

Acknowledgments .....	3
Summary.....	4
San Jose Litter Assessment (2009).....	6
Alberta Litter Survey (2009).....	7
San Jose Street Litter Audit (2008).....	8
KAB National Litter Survey (2008).....	9
San Francisco Street Litter Survey (2008).....	10
San Francisco Street Litter Survey (2007).....	11
Alberta Highway Litter Characterization (2007).....	12
Toronto Litter Survey (2006).....	13
Toronto Litter Survey (2004).....	14
Region of Peel Litter Survey (2003).....	15
Region of Durham Litter Survey (2003).....	16
Region of York Litter Survey (2003).....	17
Toronto Litter Survey (2002).....	18
Florida Statewide Litter Survey (2002).....	19
Florida Statewide Litter Survey (2001).....	20
Florida Statewide Litter Survey (1997).....	21
Florida Statewide Litter Survey (1996).....	22
Florida Statewide Litter Survey (1995).....	23
Florida Statewide Litter Survey (1994).....	24
Other Pertinent Litter Studies.....	25
FoLAR Los Angeles River Surveys.....	25
2010 Northeast Litter Survey.....	26
California 2003-04 Waste Q&C.....	26
California 1980-81 Litter Survey.....	26
US-EPA 2010 MSW Generation Data.....	27
Conclusion.....	28
Bibliography.....	29
Appendix A – CV Brief.....	31

## **Acknowledgments**

Thanks to the following people for their time and assistance regarding details about the surveys and data included in this report: Allan Mazur (City of Toronto), Emy Mendoza (City of San Jose), John Schert (Hinckley Center), Mark McKenney (MGM Management), Shelly Schneider (ERG), and Ronald Visco, Ph.D. (Environmental Resources Planning, LLC).

This study was underwritten by American Chemistry Council's Plastics Foodservice Packaging Group.

## Summary

This report examined a variety of litter surveys to determine the extent to which polystyrene (“PS”) foam food service products contribute to litter.

Surveys included in this review met the following criteria:

1. Statistically valid quantification and characterization methodologies were used.
2. PS foam food service products were specifically quantified.
3. Littered items were quantified by count. Counts are much more precise and have lower variability between measurements than either volume or weight, which are both useful measures, but only when recorded along with a tally of littered items.
4. No survey conducted before 1994 was included, because the information might be considered outdated<sup>1</sup>.

Table 1 shows each litter survey evaluated by year and the percentage of items identified as PS foam food service products in large litter. These items were rarely observed in small litter, as discussed later in this report.

**Table 1 – PS Foam Food Service Products in Large Litter**

<b>Survey</b>	<b>Year</b>	<b>Percent</b>
San Jose	2009	2.3%
Alberta	2009	0.7%
San Jose	2008	0.8%
National	2008	1.7%
San Francisco	2008	1.1%
San Francisco	2007	1.7%
Alberta	2007	1.1%
Toronto	2006	1.1%
Toronto	2004	1.0%
Region of Peel	2003	0.5%
Region of Durham	2003	0.6%
Region of York	2003	0.3%
Toronto	2002	1.5%
Florida	2002	2.3%
Florida	2001	2.2%
Florida	1997	3.1%
Florida	1996	3.6%
Florida	1995	3.3%
Florida	1994	3.9%
<b>Median Value</b>		<b>1.5%</b>

<sup>1</sup> The 1980-81 California Litter Survey was referenced in the “Other Pertinent Litter Surveys” section.

Each of these litter studies surveyed large and small items separately, excepting one, which did not survey small litter at all. All of the surveys included defined large litter as items four square inches or larger with one exception. The 2008 National Litter Survey characterized large litter as items longer than four inches.

Since the data in Table 1 consists of percentages from surveys representing a variety of population sizes and areas, the median is the appropriate measure for determining an average value. For the 19 surveys included, the median percentage of PS foam food service products in litter is 1.5 percent. Evaluating just the surveys conducted since 2000 yields an even lower median value of 1.1 percent. The scope and resulting data for each of these surveys is summarized in this report.

Several additional statistically-based litter and waste characterization surveys did not specifically address PS foam food service products as components of litter; however, each one provided additional insights into the contribution of PS foam food service materials to litter. The following studies were summarized in the "Other Pertinent Litter Surveys" section along with US-EPA's data regarding the amount of PS foam product discards in municipal solid waste.

1. FoLAR Trash Biography of LA River: 2004-2011 (2011)
2. Northeast Litter Survey (2010)
3. California Statewide Waste Characterization (2003-2004)
4. California 1980-81 Litter Survey

# San Jose Litter Assessment (2009)

## General Scope

**Survey Underwriter:** City of San Jose, Environmental Services Department.

**Date of Survey:** August 2009.

**Number of Sites:** 48 litter hot spots.

**Methodology:** Items were categorized as large ( $\geq$  four square inches) or small ( $<$  four square inches) litter. Some street sections were exactly 200 feet long with a maximum width of 18 feet, while others were 60 feet long by 60 feet wide.

## Large Litter

**Categories:** Large litter was counted and classified into 16 categories and 97 sub-categories, including four specific categories for PS foam food service products: cups, plates, clamshells and trays.

**Data:** 181 of the total 7,917 pieces (2.4 percent) of large litter observed were classified as PS foam food service products.

**Table 2 - San Jose 2009**

<b>Product</b>	<b>Items</b>	<b>Percent</b>
Cups	128	1.6%
Plates	29	0.4%
Clamshell	12	0.2%
Trays	12	0.2%
<b>Total</b>	<b>181</b>	<b>2.4%</b>

## Small Litter

**Categories:** Small litter was classified into 16 categories.

**Area Surveyed:** Nine sections within the site. Each section was six square feet in size.

**Data:** None of the small litter was identified as PS foam food service products.

# Alberta Litter Survey (2009)

## General Scope

**Survey Underwriter:** Alberta Transportation Highway Operations, Technical Standards Branch in Edmonton, AB.

**Date of Survey:** July 2009.

**Number of Sites:** 103 randomly selected highway sites.

**Methodology:** Items were categorized as large ( $\geq$  four square inches) or small ( $<$  four square inches) litter. Each site measured 200 feet long with a maximum width of 18 feet.

## Large Litter

**Categories:** Large litter was counted and classified into 84 categories, including four specific categories for PS foam food service products: cups, plates, clamshells and trays.

**Data:** 23 of the total 3,407 pieces (0.7 percent) of large litter observed were classified as PS foam food service products.

**Table 3 - Alberta 2009**

<b>Product</b>	<b>Items</b>	<b>Percent</b>
Cups	21	0.6%
Plates	0	0.0%
Clamshell	0	0.0%
Trays	2	0.1%
<b>Total</b>	<b>23</b>	<b>0.7%</b>

## Small Litter

**Categories:** Small litter was classified into 16 categories.

**Area Surveyed:** Three transects: one at the start of the site, one at the mid-point and one at the end of the site.

**Data:** None of the small litter was identified as PS foam food service products.

# San Jose Street Litter Audit (2008)

## General Scope

**Survey Underwriter:** City of San Jose, Environmental Services Department.

**Date of Survey:** August 2008

**Number of Sites Surveyed:** 124 randomly selected sites within the City's Urban Service Area.

**Methodology:** Items were categorized as large ( $\geq$  four square inches) or small ( $<$  four square inches) litter. Each site measured 200 feet in length with a maximum width of 18 feet.

## Large Litter

**Categories:** Large litter was counted and classified into 14 categories and 84 sub-categories, including four specific categories for PS foam food service products: cups, plates, clamshells and trays.

**Data:** 32 of the 3,928 pieces (0.8 percent) of large litter observed were classified as PS foam food service products.

**Table 4 - San Jose 2008**

<b>Product</b>	<b>Items</b>	<b>Percent</b>
Cups	26	0.65%
Plates	4	0.10%
Clamshell	2	0.05%
Trays	0	0.00%
<b>Total</b>	<b>32</b>	<b>0.8%</b>

## Small Litter

**Categories:** Small litter was classified into 16 categories.

**Area Surveyed:** Three transects: one at the start of the site, one at the mid-point and one at the end of the site.

**Data:** None of the small litter was identified as PS foam food service products.



# KAB National Litter Survey (2008)

## General Scope

**Survey Underwriter:** Keep America Beautiful.

**Date of Survey:** June through August 2008.

**Number of Sites:** 240 sites located on randomly selected national, state, county and municipal roads in or near metropolitan areas in each of 45 states which were also randomly selected.

**Methodology:** Items were categorized as large ( $\geq$  four inches in length) or small ( $<$  four inches in length) litter. Each site measured 300 feet in length with a maximum width of 15 feet.

## Large Litter

**Categories:** Large litter was counted and classified into 62 categories, including one category that specifically covered all PS foam food service products: cups, plates, clamshells and trays.

**Data:** 10 of the 608 pieces (1.7 percent) of large litter observed per mile (average) were classified as PS foam food service products.

## Small Litter

**Categories:** Small litter was counted and classified into 63 categories.

**Area Surveyed:** A 150 square foot subsection at the beginning of each site.

**Data:** 31 of the average 6,121 pieces (0.5 percent) of small litter observed per mile were identified as PS foam food service products.

# San Francisco Street Litter Survey (2008)

## General Scope

**Survey Underwriter:** City and County of San Francisco, Department of Environment.

**Date of Survey:** April 2008.

**Number of Sites:** 132 randomly selected sites, including the same sites that were surveyed in 2007 and augmented with additional sites.

**Methodology:** Items were quantified as either large litter ( $\geq$  four square inches) or small litter ( $<$  four square inches). Each site measured 200 feet in length with a maximum width of 18 feet.

## Large Litter

**Categories:** Large litter was counted and classified into 84 categories, including four specific categories for PS foam food service products: cups, plates, clamshells and trays.

**Data:** 45 of the 3,973 pieces (1.1 percent) of large litter observed were classified as PS foam food service products. The resulting data is the average of two passes, which yielded a fraction for certain items. Thus, columns may not add to the exact total due to rounding.

**Table 5 - San Francisco 2008**

<b>Product</b>	<b>Items</b>	<b>Percent</b>
Cups	31	0.78%
Plates	4	0.10%
Clamshell	8	0.19%
Trays	3	0.06%
<b>Total</b>	<b>45</b>	<b>1.1%</b>

## Small Litter

**Categories:** Small litter was classified into 16 categories.

**Area Surveyed:** Three transects: one at the start of the site, one at the mid-point and one at the end of the site.

**Data:** None of the small litter was identified as PS foam food service products.

# San Francisco Street Litter Survey (2007)

## General Scope

**Survey Underwriter:** City and County of San Francisco, Department of Environment.

**Date of Survey:** April 2007.

**Number of Sites:** 105 randomly selected sites, including 75 percent that were within the City's service area and 25 percent representing the remaining portion of the City.

**Methodology:** Items were quantified as either large litter ( $\geq$  four square inches) or small litter ( $<$  four square inches). Each site measured 200 feet in length with a maximum width of 18 feet.

## Large Litter

**Categories:** Large litter was counted and classified into 84 categories, including four specific categories for PS foam food service products: cups, plates, clamshells and trays.

**Data:** 68 of the 3,812 pieces (1.7 percent) of large litter observed were classified as PS foam food service products. The resulting data is the average of two passes, which yielded a fraction for certain items. Thus, columns may not add to the exact total due to rounding.

**Table 6 - San Francisco 2007**

<b>Product</b>	<b>Items</b>	<b>Percent</b>
Cups	43	1.1%
Plates	4	0.1%
Clamshell	21	0.5%
Trays	1	0.0%
<b>Total</b>	<b>68</b>	<b>1.7%</b>

## Small Litter

**Categories:** Small litter was classified into 16 categories.

**Area Surveyed:** Three transects: one at the start of the site, one at the mid-point and one at the end of the site.

**Data:** None of the small litter was identified as PS foam food service products.

# Alberta Highway Litter Characterization (2007)

## General Scope

**Survey Underwriter:** Recycling Council of Alberta, Alberta Environment, Beverage Container Management Board, Alberta Dairy Council Milk Container Recycling Program.

**Date of Survey:** May 2007.

**Number of Sites:** 47 highway sites selected by 4H clubs.

**Methodology:** Only items categorized as large ( $\geq$  four square inches) were recorded as observed litter. Each site measured 200 feet in length with a maximum width of 18 feet.

## Large Litter

**Categories:** Large litter was counted and classified into 84 categories, including four specific categories for PS foam food service products: cups, plates, clamshells and trays.

**Data:** 16 of the total 1,391 pieces (1.1 percent) of large litter observed were classified as PS foam food service products.

**Table 7 - Alberta 2007**

<b>Product</b>	<b>Items</b>	<b>Percent</b>
Cups	11	0.8%
Plates	2	0.1%
clamshell	1	0.1%
Trays	2	0.1%
<b>Total</b>	<b>16</b>	<b>1.1%</b>

## Small Litter

**Note:** Small litter was not characterized in this survey.

# Toronto Litter Survey (2006)

## General Scope

**Survey Underwriter:** City of Toronto Citizen Focused Services B, Solid Waste Management Services Division.

**Date of Survey:** July through August 2006.

**Number of Sites:** 298 randomly selected sites, including the same sites that were surveyed in 2002 and augmented with additional sites.

**Methodology:** Items were quantified as either large litter ( $\geq$  four square inches) or small litter ( $<$  four square inches). Each site measured 200 feet in length with a maximum width of 18 feet.

## Large Litter

**Categories:** Large litter was counted and classified into 84 categories, including four specific categories for PS foam food service products: cups, plates, clamshells and trays.

**Data:** 45 of the 4,341 pieces (1.0 percent) of large litter observed were classified as PS foam food service products.

**Table 8 - Toronto 2006**

<b>Product</b>	<b>Items</b>	<b>Percent</b>
Cups	41	0.9%
Plates	0	0.0%
Clamshell	1	0.0%
Trays	3	0.1%
<b>Total</b>	<b>45</b>	<b>1.0%</b>

## Small Litter

**Categories:** Small litter was classified into 16 categories.

**Area Surveyed:** Small litter was counted over the full area of 55 sites.

**Data:** None of the small litter was identified as PS foam food service products.

# Toronto Litter Survey (2004)

## General Scope

**Survey Underwriter:** City of Toronto Works and Emergency Services, Solid Waste Management Services Division.

**Date of Survey:** July through August 2006.

**Number of Sites:** 247 (the same randomly selected sites surveyed in 2002).

**Methodology:** Items were counted and quantified as either large litter ( $\geq$  four square inches) or small litter ( $<$  four square inches). Each site measured 200 feet in length with a maximum width of 18 feet.

## Large Litter

**Categories:** Large litter was counted and classified into 84 categories, including four specific categories for PS foam food service products: cups, plates, clamshells and trays.

**Data:** 50 of the 5,243 pieces (1.0 percent) of large litter observed were classified as PS foam food service products.

**Table 9 - Toronto 2004**

<b>Product</b>	<b>Items</b>	<b>Percent</b>
Cups	33	0.6%
Plates	6	0.1%
Clamshell	4	0.1%
Trays	7	0.1%
<b>Total</b>	<b>50</b>	<b>1.0%</b>

## Small Litter

**Categories:** Small litter was classified into 15 categories. Gum litter was added as a 16<sup>th</sup> category.

**Area Surveyed:** Small litter was counted in three transects: one at the start of the site, one at the mid-point and one at the end of the site. In addition, all small litter was counted at 47 sites to evaluate the accuracy of surveying small transects. The study only published the transect data.

**Data:** None of the small litter was identified as PS foam food service products.

# Region of Peel Litter Survey (2003)

## General Scope

**Survey Underwriter:** Regional Municipality of Peel, Waste Management Division.

**Date of Survey:** June 2003.

**Number of Sites:** 196 randomly selected sites, representing all road sections in the Region of Peel.

**Methodology:** Items were quantified as either large litter ( $\geq$  four square inches) or small litter ( $<$  four square inches). Each site measured 200 feet in length with a maximum width of 18 feet.

## Large Litter

**Categories:** Large litter was counted and classified into 84 categories, including four specific categories for PS foam food service products: cups, plates, clamshells and trays.

**Data:** 25 of the 4,363 pieces (0.5 percent) of large litter observed were classified as PS foam food service products.

**Table 10 - Peel 2003**

<b>Product</b>	<b>Items</b>	<b>Percent</b>
Cups	15	0.3%
Plates	5	0.1%
Clamshell	4	0.1%
Trays	1	0.0%
<b>Total</b>	<b>25</b>	<b>0.5%</b>

## Small Litter

**Categories:** Small litter was classified into 15 categories.

**Area Surveyed:** Three transects: one at the start of the site, one at the mid-point and one at the end of the site.

**Data:** None of the small litter was identified as PS foam food service products.

# Region of Durham Litter Survey (2003)

## General Scope

**Survey Underwriter:** Regional Municipality of Durham, Waste Management Division.

**Date of Survey:** June 2003.

**Number of Sites:** 199 randomly selected sites, representing all road sections in the Region of Durham, 30 percent in rural areas and 70 percent in urban and populated areas.

**Methodology:** Items were quantified as either large litter ( $\geq$  four square inches) or small litter ( $<$  four square inches). Each site measured 200 feet in length with a maximum width of 18 feet.

## Large Litter

**Categories:** Large litter was counted and classified into 84 categories, including four specific categories for PS foam food service products: cups, plates, clamshells and trays.

**Data:** 35 of the 5,698 pieces (0.6 percent) of large litter observed were classified as PS foam food service products.

**Table 11 - Durham 2003**

<b>Product</b>	<b>Items</b>	<b>Percent</b>
Cups	22	0.4%
Plates	1	0.0%
Clamshell	9	0.2%
Trays	3	0.1%
<b>Total</b>	<b>35</b>	<b>0.6%</b>

## Small Litter

**Categories:** Small litter was classified into 15 categories.

**Area Surveyed:** Three transects: one at the start of the site, one at the mid-point and one at the end of the site.

**Data:** None of the small litter was identified as PS foam food service products.



## Region of York Litter Survey (2003)

### General Scope

**Survey Underwriter:** Regional Municipality of York Solid Waste Management Branch, Transportation & Works Department.

**Date of Survey:** July 2003.

**Number of Sites:** 205 randomly selected sites, representing all road sections in the Region of York, 30 percent in rural areas and 70 percent in urban and populated areas.

**Methodology:** Items were quantified as either large litter ( $\geq$  four square inches) or small litter ( $<$  four square inches). Each site measured 200 feet in length with a maximum width of 18 feet.

### Large Litter

**Categories:** Large litter was counted and classified into 84 categories, including four specific categories for PS foam food service products: cups, plates, clamshells and trays.

**Data:** 22 of the 8,678 pieces (0.3 percent) of large litter observed were classified as PS foam food service products.

**Table 12 - York 2003**

<b>Product</b>	<b>Items</b>	<b>Percent</b>
Cups	12	0.1%
Plates	1	0.0%
Clamshell	9	0.1%
Trays	0	0.0%
<b>Total</b>	<b>22</b>	<b>0.3%</b>

### Small Litter

**Categories:** Small litter was classified into 15 categories.

**Area Surveyed:** Three transects: one at the start of the site, one at the mid-point and one at the end of the site.

**Data:** None of the small litter was identified as PS foam food service products.

# Toronto Litter Survey (2002)

## General Scope

**Survey Underwriter:** City of Toronto Works and Emergency Services, Solid Waste Management Services Division.

**Date of Survey:** in July 2002.

**Number of Sites:** 247 randomly selected sites, 60 percent in downtown Toronto and 40 percent representing the rest of the City of Toronto.

**Methodology:** Items were quantified as either large litter ( $\geq$  four square inches) or small litter ( $<$  four square inches). Each site measured 200 feet in length with a maximum width of 18 feet.

## Large Litter

**Categories:** Large litter was counted and classified into 80 categories, including four specific categories for PS foam food service products: cups, plates, clamshells and trays.

**Data:** 93 of the 6,200 pieces (1.5 percent) of large litter observed were classified as PS foam food service products.

**Table 13 - Toronto 2002**

<b>Product</b>	<b>Items</b>	<b>Percent</b>
Cups	51	0.8%
Plates	0	0.0%
Clamshell	42	0.7%
Trays	0	0.0%
<b>Total</b>	<b>93</b>	<b>1.5%</b>

## Small Litter

**Categories:** Small litter was classified into 15 categories.

**Area Surveyed:** Three transects: one at the start of the site, one at the mid-point and one at the end of the site.

**Data:** None of the small litter was identified as PS foam food service products.

# Florida Statewide Litter Survey (2002)

## General Scope

**Survey Underwriter:** Florida Legislature and Florida Department of Environmental Protection.

**Date of Survey:** January through April 2002.

**Number of Sites:** 670 randomly selected sites, stratified to yield 10 sites in each of Florida's 67 counties.

**Methodology:** Items were quantified as either large litter ( $\geq$  four square inches) or small litter ( $<$  four square inches). Each site measured 200 feet in length. Half of the sites were 18 feet wide, while the other half varied in width from 5 to 40 feet.

## Large Litter

**Categories:** Large litter was counted and classified into 72 categories, including four specific categories for PS foam food service products: cups, plates, clamshells and trays.

**Data:** 684 of the 30,317 pieces (2.3 percent) of large litter observed were classified as PS foam food service products. The resulting data is the average of two passes, which yielded a fraction for certain items. Thus, columns may not add to the exact total due to rounding.

**Table 14 - Florida 2002**

<b>Product</b>	<b>Items</b>	<b>Percent</b>
Cups	571	1.9%
Plates	53	0.2%
Clamshell	42	0.1%
Trays	19	0.1%
<b>Total</b>	<b>684</b>	<b>2.3%</b>

## **Small Litter**

**Categories:** Small litter was classified into 14 categories.

**Area Surveyed:** Three transects of each site. Each transect measured one foot long and up to 15 feet wide, depending on the site width.

**Data:** None of the small litter was identified as PS foam food service products.

# Florida Statewide Litter Survey (2001)

## General Scope

**Survey Underwriter:** Florida Legislature and Florida Department of Environmental Protection.

**Date of Survey:** January through April 2001.

**Number of Sites:** 670 randomly selected sites, stratified to yield 10 sites in each of Florida's 67 counties.

**Methodology:** Measured large litter ( $\geq$  four square inches) and small litter ( $<$  four square inches). Each site measured 200 feet in length. Half of the sites were 18 feet wide, while the other half varied in width from 5 to 40 feet.

## Large Litter

**Categories:** Large litter was counted and classified into 72 categories, including four specific categories for PS foam food service products: cups, plates, clamshells and trays.

**Data:** 599 of the 27,183 pieces (2.2 percent) of large litter observed were classified as PS foam food service products. The resulting data is the average of two passes, which yielded a fraction for certain items. Thus, columns may not add to the exact total due to rounding.

**Table 15 - Florida 2001**

<b>Product</b>	<b>Items</b>	<b>Percent</b>
Cups	435	1.6%
Plates	27	0.1%
Clamshell	25	0.1%
Trays	112	0.4%
<b>Total</b>	<b>599</b>	<b>2.2%</b>

## **Small Litter**

**Categories:** Small litter was classified into 14 categories.

**Area Surveyed:** Surveyed on three transects of each site. Each transect measured one foot long and up to 15 feet wide, depending on the site width.

**Data:** None of the small litter was identified as PS foam food service products.

# Florida Statewide Litter Survey (1997)

## General Scope

**Survey Underwriter:** Florida Legislature and Florida Department of Environmental Protection.

**Date of Survey:** January through April 1997.

**Number of Sites:** 670 randomly selected sites, stratified to yield 10 sites in each of Florida's 67 counties.

**Methodology:** Measured large litter ( $\geq$  four square inches) and small litter ( $<$  four square inches). Each site measured 200 feet in length. Half of the sites were 18 feet wide, while the other half varied in width from 5 to 40 feet.

## Large Litter

**Categories:** Large litter was counted and classified into 72 categories, including four specific categories for PS foam food service products: cups, plates, clamshells and trays.

**Data:** 1,069 of the 34,794 pieces (3.1 percent) of large litter observed were classified as PS foam food service products. The resulting data is the average of two passes, which yielded a fraction for certain items. Thus, columns may not add to the exact total due to rounding.

**Table 16 - Florida 1997**

<b>Product</b>	<b>Items</b>	<b>Percent</b>
Cups	918	2.7%
Plates	35	0.1%
Clamshell	69	0.2%
Trays	48	0.1%
<b>Total</b>	<b>1,069</b>	<b>3.1%</b>

## Small Litter

**Categories:** Small litter was classified into 14 categories.

**Area Surveyed:** Surveyed on three transects of each site. Each transect measured one foot long and up to 15 feet wide, depending on the site width.

**Data:** None of the small litter was identified as PS foam food service products.

# Florida Statewide Litter Survey (1996)

## General Scope

**Survey Underwriter:** Florida Legislature and Florida Department of Environmental Protection.

**Date of Survey:** January through April 1996.

**Number of Sites:** 670 randomly selected sites, stratified to yield 10 sites in each of Florida's 67 counties.

**Methodology:** Measured large litter ( $\geq$  four square inches) and small litter ( $<$  four square inches). Each site measured 200 feet in length. Half of the sites were 18 feet wide, while the other half varied in width from 5 to 40 feet.

## Large Litter

**Categories:** Large litter was counted and classified into 72 categories, including four specific categories for PS foam food service products: cups, plates, clamshells and trays.

**Data:** 1,176 of the 32,633 pieces (3.6 percent) of large litter observed were classified as PS foam food service products.

**Table 17 - Florida 1996**

<b>Product</b>	<b>Items</b>	<b>Percent</b>
Cups	978	3.0%
Plates	43	0.1%
Clamshell	90	0.3%
Trays	65	0.2%
<b>Total</b>	<b>1,176</b>	<b>3.6%</b>

## Small Litter

**Categories:** Small litter was classified into 14 categories.

**Area Surveyed:** Surveyed on three transects of each site. Each transect measured one foot long and up to 15 feet wide, depending on the site width.

**Data:** None of the small litter was identified as PS foam food service products.

# Florida Statewide Litter Survey (1995)

## General Scope

**Survey Underwriter:** Florida Legislature and Florida Department of Environmental Protection.

**Date of Survey:** January and March 1995.

**Number of Sites:** 670 randomly selected sites, stratified to yield 10 sites in each of Florida's 67 counties.

**Methodology:** Measured large litter ( $\geq$  four square inches) and small litter ( $<$  four square inches). Each site measured 200 feet in length. Half of the sites were 18 feet wide, while the other half varied in width from 5 to 40 feet.

## Large Litter

**Categories:** Large litter was counted and classified into 72 categories, including four specific categories for PS foam food service products: cups, plates, clamshells and trays.

**Data:** 942 of the 28,526 pieces (3.3 percent) of large litter observed were classified as PS foam food service products. The resulting data is the average of two passes, which yielded a fraction for certain items. Thus, columns may not add to the exact total due to rounding.

**Table 18 - Florida 1995**

<u>Product</u>	<u>Items</u>	<u>Percent</u>
Cups	793	2.8%
Plates	27	0.1%
Clamshell	93	0.3%
Trays	30	0.1%
<b>Total</b>	<b>942</b>	<b>3.3%</b>

## Small Litter

**Categories:** Small litter was classified into 14 categories.

**Area Surveyed:** Surveyed on three transects of each site. Each transect measured one foot long and up to 15 feet wide, depending on the site width.

**Data:** None of the small litter was identified as PS foam food service products.

# Florida Statewide Litter Survey (1994)

## General Scope

**Survey Underwriter:** Florida Legislature and Florida Department of Environmental Protection.

**Date of Survey:** January and April 1994.

**Number of Sites:** 268 randomly selected sites, stratified to yield four sites in each of Florida's 67 counties.

**Methodology:** Measured large litter ( $\geq$  four square inches) and small litter ( $<$  four square inches). Each site measured 200 feet in length. Half of the sites were 18 feet wide, while the other half varied in width from 5 to 40 feet.

## Large Litter

**Categories:** Large litter was counted and classified into 72 categories, including four specific categories for PS foam food service products: cups, plates, clamshells and trays.

**Data:** 465 of the 11,988 pieces (3.9 percent) of large litter observed were classified as PS foam food service products. The resulting data is the average of two passes, which yielded a fraction for certain items. Thus, columns may not add to the exact total due to rounding.

**Table 19 - Florida 1994**

<b>Product</b>	<b>Items</b>	<b>Percent</b>
Cups	411	3.40%
Plates	12	0.10%
Clamshell	28	0.23%
Trays	15	0.13%
<b>Total</b>	<b>465</b>	<b>3.9%</b>

## Small Litter

**Categories:** Small litter was classified into 14 categories.

**Area Surveyed:** Surveyed on three transects of each site. Each transect measured one foot long and up to 15 feet wide, depending on the site width.

**Data:** None of the small litter was identified as PS foam food service products.



## Other Pertinent Litter Studies

Other statistically based litter surveys quantified PS foam products in general, while not specifically identifying the food service portion. While these surveys are not directly comparable to those that broke out the food service portion, they still indicate that PS foam products in general comprise a small portion of litter. Therefore, by extension, the food service portion comprises even less.

## FoLAR Los Angeles River Surveys

Friends of the Los Angeles River ("FoLAR"), a non-profit organization that works to restore the Los Angeles River, has recorded data from cleanups along various points of the river since 2004. These results were published in a November 2011 report. Table 20 includes the weights and volume data from that report for all types of PS foam products.

**Table 20 – PS Litter in FoLAR Surveys: 2004-2011**

<b>Site</b>	<b>Year</b>	<b>Wt.</b>	<b>Vol.</b>
Long Beach	2004	0.0%	2.0%
Fletcher	2004	n/a	3.2%
Willow	2004	0.9%	2.0%
Fletcher	2005	0.3%	n/a
Steelhead	2010	1.1%	1.5%
Fletcher	2009	0.5%	2.0%
Fletcher	2010	0.5%	4.7%
Balboa	2011	0.5%	0.0%
Willow	2011	0.2%	9.7%
Steelhead	2011	0.1%	1.0%
Compton	2011	1.4%	14.5%
<b>Median Values</b>		<b>0.5%</b>	<b>2.0%</b>

Some of the totals shown in Table 20 were rounded in the FoLAR report's graphics. A twelfth survey, conducted in Balboa (2010), only recorded item counts. No PS items of any type were found during that cleanup.

Since the data in Table 20 consists of percentages from surveys representing a variety of population sizes and areas, the median is the appropriate measure for determining the average value. For the 11 surveys included, the median values for all types of PS foam products in litter are 0.5 percent by weight and 2.0 percent by volume.

## **2010 Northeast Litter Survey**

The 2010 Northeast Litter Survey consisted of three separate statewide litter surveys conducted in each of the following three states: Maine, New Hampshire and Vermont. A total of 288 sites were surveyed. All types of PS foam products were tallied, including food service products and packaging. Items specifically tracked included packaging peanuts and blocks; beverage cups, clamshells and plates; ice chests and other food insulating products; construction-related insulation sheets and pieces from retail, commercial and industrial sources. All items one inch or larger were tallied.

The percentage of all PS foam products as components of litter in each state was:

- Maine: 1.3 percent
- New Hampshire: 1.4 percent
- Vermont: 1.5 percent

## **California 2003-04 Waste Q&C**

California's Integrated Waste Management Board published a statewide solid waste characterization study conducted in 2003 and 2004. While that study did not specifically characterize PS foam food service products, the "Miscellaneous Plastic Containers" category included all plastic containers other than HDPE and PET (CIWMB 2004, p. 100). This category comprised only 0.5 percent of trash by weight in California. PS foam food service products would only constitute a portion of that total.

## **California 1980-81 Litter Survey**

This survey provides important insights into the contribution of PS foam materials to the litter stream in California over time. The California State Solid Waste Management Board underwrote the California Litter Survey in 1980, led by Dr. Bruce Bechtol and Dr. Jerry Williams, Professors of Geography at California State University in Chico. That study showed that all "Styrofoam" items comprised between 2.1 percent and 2.6 percent of all litter. One-third of sites were monitored for large items only. The remaining 69 sites were audited for all litter items larger than one square centimeter in size and formed the basis of litter composition in California.

## **US-EPA 2010 MSW Generation Data**

### **General Scope**

**Survey Underwriter:** U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response (OSWER).

**Date of Survey:** This survey is based on 2010 data.

**Methodology:** A materials flow methodology is used that relies on a mass balance approach to estimate municipal solid waste generation in the U.S. by material and product. Information is gathered on material production nationwide and is augmented with data gathered from industry, associations, businesses, and government sources that track such data. Additional sources such as published studies and surveys are also utilized.

### **Materials Tracked**

**Categories:** While the US-EPA does not track litter, it does collect and report data on the components of Municipal Solid Waste ("MSW") disposal in the U.S. US-EPA classifies MSW into approximately 50 categories, including categories referencing PS products.

**Data:** The 2010 report shows that discards of all PS food service products total 720 thousand tons. All materials discarded in municipal solid waste total 164,910 thousand tons (US-EPA 2010, p. 4). All PS food service product discards, then, constitute 0.44 percent of MSW by weight.

This includes all foam and non-foam products (US-EPA 2010, p. 8). Thus, the PS foam food service products would only comprise a portion of that number.

## Conclusion

This report evaluated 19 statistically based litter surveys that specifically characterized PS foam food service products as components of litter and found that these items consistently constitute a small portion of litter (1.5 percent). Evaluating just the surveys conducted since 2000 yields an even lower median value of 1.1 percent. Additional studies that surveyed all PS foam products (food service and packaging) together also found that these items constitute a similarly small portion of litter.

## Survey Notes

Florida did not conduct litter surveys between 1998 and 2000. The last survey on record was conducted in 2002.

Florida's litter surveys included a separate category for miscellaneous PS foam in large litter. The survey author noted that these items were chunks of PS, not food service items, which were categorized separately.<sup>2</sup>

"Other Polystyrene Pieces", a minor portion of small litter, consisted primarily of broken pieces of items such as packaging materials or ice chest lids<sup>3</sup>, although it may have also included some pieces of PS foam food service products<sup>4</sup>.

Toronto's 2004 survey noted that small litter is manufactured, in part, by mowing along roadsides before litter is removed, turning several larger pieces of litter into numerous small pieces. The 2010 Northeast Litter Survey made a similar observation.

The 2007 Alberta survey noted that it did not use random site selection and, because it had not done so, the survey resulted in "higher average items per site than would be observed if random site selection was used".

The Toronto 2006 survey expanded to 86 categories from the 80 categories used in its 2002 survey. In addition, the small litter categories were expanded to 16 from the 15 categories used in its 2002 survey.

---

<sup>2</sup> Personal communication with John Schert.

<sup>3</sup> Personal communication with John Schert.

<sup>4</sup> Personal communication with Emy Mendoza (San Jose) and Allan Mazur (Toronto).

## **Bibliography**

Caltrans. Final Report - California Department of Transportation District 7 Litter Management Pilot Study. June 2000.

Cascadia Consulting Group. Contractor's Report to the Board. Statewide Waste Characterization Study. Integrated Waste Management Board. December 2004.

City of San Jose Targeted Litter Assessment. August 2009.

Environmental Resources Planning, LLC. 2010 Northeast Litter Survey. Conducted for American Beverage Association. July 2011.

Florida Center for Solid and Hazardous Waste Management. The Florida Litter Study: 1994 Conducted for The Florida Legislature and Florida Department of Environmental Protection. 1994.

Florida Center for Solid and Hazardous Waste Management. The Florida Litter Study: 1995 Conducted for The Florida Legislature and Florida Department of Environmental Protection. January 1996.

Florida Center for Solid and Hazardous Waste Management. The Florida Litter Study: 1996 Conducted for The Florida Legislature and Florida Department of Environmental Protection. April 1997.

Florida Center for Solid and Hazardous Waste Management. The Florida Litter Study: 1997 Conducted for The Florida Legislature and Florida Department of Environmental Protection. November 1997.

Florida Center for Solid and Hazardous Waste Management. The Florida Litter Study: 2001 Conducted for The Florida Legislature and Florida Department of Environmental Protection. June 2001.

Florida Center for Solid and Hazardous Waste Management. Roadside Litter in Florida: 2002 for the Florida Legislature and Florida Department of Environmental Protection. May 2002.

HDR et.al. The City of San Francisco Streets Litter Audit 2007 Prepared for The City and County of San Francisco Department of Environment. June 2007.

HDR et al. The City of San Francisco Streets Litter Re-Audit 2008 Prepared for The City and County of San Francisco Department of Environment. July 2008.

Institute for Applied Research. Methods of Litter Measurement (Report S-13.9 Revised Jan 2007). 2007.

Keep America Beautiful. 2008 National Visible Litter Survey and Litter Cost Research Study – Final Report. September 2009.

MGM Management. Alberta Transportation Litter Audit Final Report. Prepared for Alberta Transportation Highway Operations Technical Standards Branch. Edmonton, AB. August 2009.

MGM Management. Alberta Highway Litter Characterization Study. Prepared for Recycling Council of Alberta with support from Alberta Environment, Beverage Container Management Board, Alberta Dairy Council Milk Container Recycling Program. August 2007.

MGM Management. Region of Durham Litter Survey. Prepared for the Regional Municipality of Durham Waste Management Division. September 2003.

MGM Management. Region of Peel Litter Survey. Prepared for the Regional Municipality of Peel Waste Management Division. September 2003.

MGM Management. City of Toronto Streets Litter Audit. Prepared for The City of Toronto Works and Emergency Services, Solid Waste Management Services Division. September 2002.

MGM Management. City of Toronto Streets Litter Audit 2006. Prepared for Citizen Focused Services B, Solid Waste Management Services Division. October 2006.

MGM Management. The Regional Municipality of York 2003 Litter Survey. Prepared for The Regional Municipality of York Solid Waste Management Branch Transportation & Works Department. September 2003.

SAIC & MGM Management. The City of San Jose 2008 Street Litter Audit Report. Prepared for City of San Jose Environmental Services Department. February 2009.

Tyack, Nicholas. A Trash Biography. Friends of the Los Angeles River Trash Report 2004-2011. November 2011.

U.S. Environmental Protection Agency. Office of Resource Conservation and Recovery. Municipal Solid Waste Generation, Recycling, and Disposal in the United States. Tables and Figures for 2010. November 2011.

## **Appendix A – CV Brief**

# Appendix A - CV Brief

624 Main Street, Suite B ● Gaithersburg, MD 20878 ● Phone: (240) 631-6532 ● sstein@erplanning.com

Steven R. Stein is Principal of Environmental Resources Planning, LLC ("ER Planning"), the nation's most experienced firm in the field of litter-related studies and litter's effects on our communities. Mr. Stein's background in recycling dates back to the 1970s. His work with litter has been featured on ABC's *Good Morning America* and *NPR* as well as in the *New York Times* and *National Geographic Magazine*. Field crews under his direction have physically surveyed litter along more than 15.5 million square feet of roadways and recreational areas.

He has taught *Environmental Science* and *Ethics in Management* at the university level and was recently invited to participate in a study prepared for the President as a subject matter expert on environmental issues and community dynamics.

## **Selected Litter-Related Projects**

- ✚ Contribution of Polystyrene Foam Food Service Products to Litter (2012)
- ✚ 2012 Paper and Plastic Bag Litter Survey (2012)
- ✚ Technical Analysis of BASMAA MS4s Stormwater Trash Reports (2012)
- ✚ Sustainable Consumption Expert Roundtable, Johnson Foundation (2012)
- ✚ Ocean Conservancy - Beach Litter Survey Methodology (2011)
- ✚ LA County Trash Biography, FoLAR – Peer Review (2011)
- ✚ National Litter Forum: Restoring Our Communities - Organizer and Sponsor (2011)
- ✚ President's National Infrastructure Advisory Council Report – Contributor (2010)
- ✚ 2010 Northeast Litter Survey (Maine, New Hampshire, Vermont) - Project Manager (2011)
- ✚ 2008 National Litter Survey and Litter Cost Research Study - Project Manager (2009)
- ✚ Community Appearance Index (Keep America Beautiful) - Project Manager (2008)
- ✚ Keep America Beautiful Litter Research Forum (2007)
- ✚ Litter: Literature Review - Report Author (2007)
- ✚ Ocean Conservancy's National Marine Debris Monitoring Program - Pro Bono Survey Director for Chincoteague Island, VA Site (2006-2007)
- ✚ Potomac Watershed Initiative Trash Monitoring Protocol Subcommittee - Pro Bono (2006-2007)
- ✚ Georgia Visible Litter Survey - Project Manager (2006)
- ✚ Tennessee Visible Litter Survey - Project Manager (2006)
- ✚ California Beach Litter Study - Project Manager (2005-2006)
- ✚ New Jersey Litter Study - Project Manager (2004)
- ✚ North Carolina Litter Study - Co-author (2001)



## **Educational Background**

- ✔ **Ph.D. Level Coursework** – *Environmental Science*, SUNY College of Environmental Science and Forestry (SUNY-ESF)/Syracuse University (SU). Focus of studies: The influence of cultural archetypes on littering behavior. Authored a literature review of behavioral and litter quantification/characterization studies conducted between 1968 and 2006.
- ✔ **M.Sci.** – *Natural Resource Policy and Management*, SUNY-ESF/SU. Focus of studies: Macroeconomic relationship of Asian/U.S. recycling industries and evaluation of sustainable policy initiatives. Master’s thesis examined the implications of public policy intervention on the establishment of sustainable domestic recycling markets. Studied under two forest economists. Recipient of New York SWANA Annual Scholarship Award.
- ✔ **B.Sci. Cum Laude** – *Environmental Studies*, SUNY-ESF/SU. Focus of studies: *Waste Management* and *Environmental Law*. Teaching assistant for Dr. Allen Lewis’s *Introduction to Environmental Studies* course. Internship with New York State DEC.

For further information about our firm's work with litter and other environmental issues, go to: [www.erplanning.com](http://www.erplanning.com)

Steven R. Stein, Principal  
Environmental Resources Planning, LLC  
624 Main Street, Suite B  
Gaithersburg, MD 20878

Office: (240) 631-6532

Email: [sstein@erplanning.com](mailto:sstein@erplanning.com)

